REMARKS

This Request for Continued Examination is intended as a full and complete response to the Final Office Action dated October 4, 2005, and has a period set to expire on May 6, 2006, in view of the Notice of Appeal filed February 6, 2006, having a period to file a brief extended by one month. Please enter this Request and reconsider the claims pending in the application for reasons discussed below.

Claims 8-10, 20-22, 31-33, and 37-59 remain pending in the application upon entry of this Request. Claims 37-59 have been added by the Applicant. Claims 8-10, 20-22, and 31-33 stand rejected by the Examiner. Reconsideration of the rejected claims is requested for reasons presented below.

The Applicant appreciates the Examiner's efforts to advance prosecution of this application during several telephone interviews. Claims 8, 20, and 31 have been amended to further clarify the claimed invention.

Claims 8-9, 20-21, and 31-32 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *Miura et al.*, US 2003-0155247 (herein, "*Miura*"), in combination with *Baskaran et al.*, US 2004-0072419 (herein, "*Baskaran*") and further in view of *Dubin et al.*, U.S. Pat. No. 6,432,821 (herein, "*Dubin*"). The Examiner asserts that the claimed invention would have been obvious to one having ordinary skill in the art by modifying *Miura* in combination with *Baskaran* and further in view of *Dubin*. The Applicant respectfully traverses the rejection.

Miura discloses a process which provides the deposition of a tantalum nitride barrier layer using a sputtering technique, the deposition of a copper seed layer using a sputtering technique and the application of electrolytic copper plating to fill or half fill trenches or via holes on the substrate. (see [0059] to [0061]). The Examiner asserts that *Miura* discloses "reducing the complexed copper ions with the electrical bias to deposit the *copper seed layer onto the barrier layer* (pages 3-4 [0049] to [0051])." (*emphasis added*) (Office Action mailed 10/04/05, page 5). However, *Miura* discloses forming a barrier layer, depositing a conductive seed layer "prior to application of electrolytic copper plating" by a PVD technique or a CVD technique, and subsequently, commencing with an electrolytic copper plating process. (see [0049] to [0051]).

During a telephone interview, the Examiner stated that *Miura* may have a discontinuous seed layer that exposes the underlying barrier layer. The Examiner further stated that *Muira* teaches once the electrolytic plating of the copper fill has started, any exposed barrier layer could be plated by copper.

The Applicant respectively disagrees with the Examiner's interpretation of *Miura*. The Applicant can not find within the disclosure of *Miura* that the seed layer is discontinuous. *Miura* discloses forming a conductive layer "commonly referred to as a seed layer and is generally formed by CVD or PVD," that "is generally formed to an average thickness of 100 to 200 nm" and "the thickness can vary significantly with *the thinnest part having a thickness less than half the average thickness*." (see [0006], last sentence and all of [0007]). Generally, discontinuous seed layers have exposed underlayer areas since the seed layer thickness tapers to having no thickness, hence the seed layer is discontinuous. Therefore, *Miura* should have a continuous seed layer across the substrate with the thinnest part having a thickness of 50-100 nm.

The Examiner further notes that *Miura* differs from the instant invention because *Miura* does not disclose that the complexed copper ions are derived from a copper source selected from the group consisting of copper citrate, copper borate, copper tartrate, copper oxalate, derivates thereof and combinations thereof. (Office Action mailed 10/04/05, page 6).

Baskaran discloses a process for electroplating copper onto a barrier from a plating bath solution which contains copper sulfate and a complexing agent. *Baskaran* further discloses that copper citrate may alternatively be used instead of copper sulfate. However, *Baskaran* teaches away from the instant invention which claims that the copper solution has a pH value of less than 7 (claims 8 and 20). *Baskaran* discloses that the "alkaline electrolytic bath solution is maintained at a pH of at least about 9.0" and a "suitable pH for a citric acid or ED bath solution is about 9.5." (see [0076]). Although copper citrate is not a citric acid bath solution, the Examiner states that "[c]omplexing the copper ions with citric acid would give copper citrate." (Office Action mailed 10/04/05, page 6).

The Applicant further asserts that the Examiner has not supplied the requisite motivation to combine *Miura*, which discloses depositing a copper seed layer by a

sputtering technique and electrolytic copper plating to fill or half fill trenches or via holes, with *Baskaran*, which discloses maintaining the alkaline electrolytic bath solution at a pH of at least about 9.0 and a citric acid bath solution has a suitable pH at about 9.5. The Applicant notes that "[t]he showing of a motivation to combine must be clear and particular, and it must be supported by actual evidence. *In re Dembiczak*, 50 U.S.P.Q. 2d 1614, 1617 (Fed. Cir. 1999).

The Examiner has failed to show a clear and particular motivation by the skilled artisan to select from the entire disclosure of *Baskaran*, a reference to copper citrate for combination with *Miura*, while ignoring the remainder of *Baskaran*. On this point, the Federal Circuit has ruled that "[o]ne cannot use hindsight reconstruction to pick and choose among isolated disclosures in the prior art to deprecate the claimed invention." (*In re Fritch* at 1784). In order to avoid using the Applicant's disclosure as a blueprint to pick and choose certain elements, while ignoring others, the Examiner must supply a clear and particular motivation or suggestion to do so. The need for a clear and particular motivation is even stronger when a selected element is only mentioned once and taught as peripheral to the method of focus. In the present case, the Examiner must show that, in the context of *Baskaran*, that copper citrate is taught as having a clear significance beyond that provided in the Applicant's disclosure. Otherwise, the true motivation is forbidden hindsight.

The Examiner has yet to show such a suggestion. In *Baskaran*, the only mention of copper citrate is in a list of alternative copper sources. The Examiner must show that the skilled artisan would be motivated to specifically select copper citrate from the eight potential copper sources listed in *Baskaran* for combining with *Miura*, despite *Baskaran*'s failure to teach any particular advantages offered by copper citrate. Otherwise, the Examiner can only be applying an "obvious to try" standard. The Examiner has not shown that the skilled artisan would be motivated to select copper citrate in combining *Baskaran* with *Miura*.

Further, *Dubin* discloses a process to force a first forward current, a second forward current and a third forward current for depositing an initiation layer, a feature fill layer and a bulk layer. The process disclosed by *Dubin* includes sequential reverse

current steps within a single copper plating solution. Therefore, the same chemical components are maintained throughout the various steps disclosed by *Dubin*.

Therefore, *Miura*, *Baskaran*, and *Dubin*, alone or in combination, do not teach, show, or suggest a method for depositing a copper-containing seed layer onto a barrier material layer, comprising providing a substrate having a barrier layer disposed on a substrate surface, wherein the barrier layer has a barrier surface selected from the group consisting of a tungsten surface, a tungsten nitride surface, a titanium surface, a titanium nitride surface, a cobalt surface, a ruthenium surface, a nickel surface, and a silver surface, exposing the substrate to a copper solution containing complexed copper ions and having a pH value of less than 7, wherein the complexed copper ions are derived from a copper source selected from the group consisting of copper citrate, copper borate, copper tartrate, copper oxalate, derivates thereof, and combinations thereof, applying an electrical bias across the substrate surface to chemically reduce the complexed copper ions and to deposit a copper seed layer onto the barrier surface, and depositing a copper gap-fill layer by exposing the substrate to a second copper solution containing free-copper ions, and applying a second electrical bias across the substrate surface to deposit the copper gap-fill layer onto the copper seed layer, as recited in claim 8, and claim 9 dependent thereon.

Also, *Miura*, *Baskaran*, and *Dubin*, alone or in combination, do not teach, show, or suggest a method for depositing a copper-containing seed layer onto a barrier material layer, comprising providing a substrate having a barrier layer disposed on a substrate surface, wherein the barrier layer has a barrier surface selected from the group consisting of a tungsten surface, a tungsten nitride surface, a titanium surface, a titanium nitride surface, a cobalt surface, a ruthenium surface, a nickel surface, and a silver surface, exposing the substrate to a complexed copper solution containing complexed copper ions and having a pH value of less than 7, reducing the complexed copper ions with a first electrical bias to form a copper seed layer on the barrier surface, and depositing a copper gap-fill layer by exposing the substrate to a first copper solution containing free-copper ions, and applying a second electrical bias across the substrate surface to deposit the copper gap-fill layer onto the copper seed layer, as recited in claim 20, and claim 21 dependent thereon.

Also, *Miura*, *Baskaran*, and *Dubin*, alone or in combination, do not teach, show, or suggest a method for depositing a copper-containing seed layer onto a barrier material layer, comprising providing a substrate having a barrier layer disposed on a substrate surface, wherein the barrier layer has a barrier surface selected from the group consisting of a tungsten surface, a tungsten nitride surface, a titanium surface, a titanium nitride surface, a cobalt surface, a ruthenium surface, a nickel surface, and a silver surface, exposing the substrate to a complexed copper solution containing complexed copper ions derived from a copper source selected from the group consisting of copper citrate, copper borate, copper tartrate, copper oxalate, derivates thereof, and combinations thereof, reducing the complexed copper ions with a first electrical bias to form a copper seed layer on the barrier surface, wherein the first electrical bias has a current density of less than about 10 mA/cm^2 across the substrate surface, and depositing a copper gap-fill layer by exposing the substrate to a second copper solution containing free-copper ions, and applying a second electrical bias across the substrate surface to deposit the copper gap-fill layer onto the copper seed layer, as recited in claim 31, and claim 32 dependent thereon.

Withdrawal of the rejection is respectfully requested.

Claims 10, 22 and 33 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *Miura* in combination with *Baskaran*, further in view of *Dubin*, and further in view of *Nagai et al.*, U.S. Pat. No. 6,709,563 (herein, "*Nagai*"). The Examiner asserts that the claimed invention would have been obvious to one having ordinary skill in the art by modifying *Miura* in combination with *Baskaran*, in view of *Dubin* and in further view of *Nagai*. The Applicant respectfully traverses the rejection.

Miura, *Baskaran*, and *Dubin* have been discussed and distinguished above. *Nagai* discloses an electrolytic process for depositing copper which includes exposing the substrate to a first plating liquid to deposit a seed layer and a second plating liquid to fill recesses with copper. The first plating liquid contains a copper source and a complexing agent and is maintained at a pH range of 7-14, preferably at a pH of about 9. The second plating liquid contains copper sulfate, sulfuric acid and an additive for enhancing the leveling property. The first plating liquid and the second plating liquid have many different chemical components. (column 16, line 8 to column 17, line 63).

Nagai discloses these two plating liquids and remains completely silent to adding a leveling additive into the first plating liquid to form the second plating liquid. The Applicant does not find disclosure within *Nagai* of a third plating liquid or a third copper solution, as asserted by the Examiner.

Therefore, *Miura*, *Baskaran*, *Dubin*, and *Nagai*, alone or in combination, do not teach, show, or suggest a method for depositing a copper-containing seed layer onto a barrier material layer, comprising providing a substrate having a barrier layer disposed on a substrate surface, wherein the barrier layer has a barrier surface selected from the group consisting of a tungsten surface, a tungsten nitride surface, a titanium surface, a titanium nitride surface, a cobalt surface, a ruthenium surface, a nickel surface, and a silver surface, exposing the substrate to a copper solution containing complexed copper ions and having a pH value of less than 7, wherein the complexed copper ions are derived from a copper source selected from the group consisting of copper citrate, copper borate, copper tartrate, copper oxalate, derivates thereof, and combinations thereof, applying an electrical bias across the substrate surface to chemically reduce the complexed copper ions and to deposit a copper seed layer onto the barrier surface, and depositing a copper gap-fill layer by exposing the substrate to a second copper solution containing free-copper ions, and applying a second electrical bias across the substrate surface to deposit the copper gap-fill layer onto the copper seed layer, as recited in claim 8, and claim 10 dependent thereon.

Also, *Miura*, *Baskaran*, *Dubin*, and *Nagai*, alone or in combination, do not teach, show, or suggest a method for depositing a copper-containing seed layer onto a barrier material layer, comprising providing a substrate having a barrier layer disposed on a substrate surface, wherein the barrier layer has a barrier surface selected from the group consisting of a tungsten surface, a tungsten nitride surface, a titanium surface, a titanium nitride surface, a cobalt surface, a ruthenium surface, a nickel surface, and a silver surface, exposing the substrate to a complexed copper solution containing complexed copper ions and having a pH value of less than 7, reducing the complexed copper ions with a first electrical bias to form a copper seed layer on the barrier surface, and depositing a copper gap-fill layer by exposing the substrate to a first copper solution containing free-copper ions, and applying a second electrical bias across the substrate

surface to deposit the copper gap-fill layer onto the copper seed layer, as recited in claim 20, and claim 22 dependent thereon.

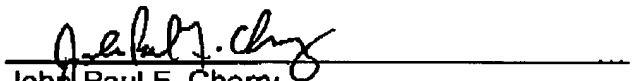
Also, *Miura*, *Baskaran*, *Dubin*, and *Nagai*, alone or in combination, do not teach, show, or suggest a method for depositing a copper-containing seed layer onto a barrier material layer, comprising providing a substrate having a barrier layer disposed on a substrate surface, wherein the barrier layer has a barrier surface selected from the group consisting of a tungsten surface, a tungsten nitride surface, a titanium surface, a titanium nitride surface, a cobalt surface, a ruthenium surface, a nickel surface, and a silver surface, exposing the substrate to a complexed copper solution containing complexed copper ions derived from a copper source selected from the group consisting of copper citrate, copper borate, copper tartrate, copper oxalate, derivates thereof, and combinations thereof, reducing the complexed copper ions with a first electrical bias to form a copper seed layer on the barrier surface, wherein the first electrical bias has a current density of less than about 10 mA/cm^2 across the substrate surface, and depositing a copper gap-fill layer by exposing the substrate to a second copper solution containing free-copper ions, and applying a second electrical bias across the substrate surface to deposit the copper gap-fill layer onto the copper seed layer, as recited in claim 31, and claim 33 dependent thereon.

Withdrawal of the rejection is respectfully requested.

In conclusion, the references cited by the Examiner, alone or in combination, do not teach, show, or suggest the claimed invention.

Having addressed all issues set out in the Final Office Action, the Applicant respectfully submits that the claims are in condition for allowance and respectfully request that the claims be allowed.

Respectfully submitted,



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